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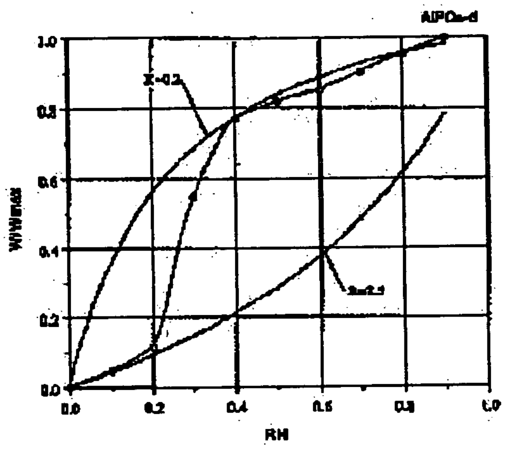
(54) DEHUMIDIFYING AIR CONDITIONER

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an energy-saving and compact dehumidifying air conditioner.

SOLUTION: This dehumidifying air conditioner has a treated air line and a regenerated air line and further a heat exchanger between the treated air with moisture adsorbed and the air to be regenerated before being dehumidified by a desiccant and heated by a heating source. The desiccant is not deliquescent, and the maximum value of the differentiated heat of adsorption when the moisture of &ge;20% of the maximum adsorption amount is adsorbed, is &le;1.1 times as high as the heat of condensation of water. Further, when the relative adsorption amount obtd. by defining the maximum adsorption amount at 90% relative humidity as the denominator and the adsorption amount as the numerator is denoted by X, the relative humidity by P and the isotherm separation factor by R, and the function shown by X=R/(R+P-R.P) is used, the adsorption isotherm exhibiting the absorption characteristics of the desiccant lies in the area enclosed between the X-P curve at R=0.2 and the X-P curve at R=2.5 in the relative humidity range of 30% to 70%.



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CLAIMS

[Claim(s)]
[Claim 1] The path of processing air in which moisture is adsorbed by DESHIKANTO. It is a heat exchanger between reproduction air before being heated by before the processing air which passes DESHIKANTO after the aforementioned water adsorption and has the path of the reproduction air which carries out the desorption of the moisture in DESHIKANTO, and is reproduced after being heated by the source of heating and by which moisture was adsorbed, and DESHIKANTO reproduction, and the source of heating. It is the dehumidification air conditioner equipped with the above, and there is no deliquescence as DESHIKANTO. The adsorption isotherm which the maximum of the differential heat of adsorption at the time of adsorbing 20% or more of moisture of the maximum amount of adsorption is 1.1 or less times of the heat of condensation of water, and shows the adsorption property of DESHIKANTO and by 70% of within the limits from 30% of relative humidity P and a constant-temperature-line separation factor are set to R for relative humidity by being set the relative amount of adsorption which makes a denominator the maximum amount of adsorption at the time of 90% of relative humidity, and defines the amount of adsorption as a molecule to X. It is characterized by using DESHIKANTO which exists within limits surrounded by the X-P curve obtained as a constant-temperature-line separation factor R= 0.2, and the X-P curve obtained as a constant-temperature-line separation factor R= 2.5 using the function expressed with formula $X=P/(R+P-R-P)$.
[Claim 2] The dehumidification air conditioner according to claim 1 characterized by using an alumina bridge formation clay porous body for DESHIKANTO.
[Claim 3] The aforementioned alumina bridge formation clay porous body is a dehumidification air conditioner according to claim 2 characterized by exchanging the convertibility cation between stratified silicate layers by the polynuclear metal hydroxyl ion containing aluminum, and carrying out heating dehydration of this.
[Claim 4] The dehumidification air conditioner according to claim 3 characterized by the aforementioned stratified silicate being nature or a synthetic smectite.
[Claim 5] The dehumidification air conditioner according to claim 1 characterized by using structure-like activated carbon for DESHIKANTO.
[Claim 6] The aforementioned structure-like activated carbon is a dehumidification air conditioner according to claim 5 which carries out carbonization processing of the polyvinyl formal, and is characterized by being what is obtained by carrying out activation at the temperature of 850 degrees C or less.
[Claim 7] The dehumidification air conditioner according to claim 1 characterized by using a porosity aluminium phosphate (molecular sieve) for DESHIKANTO.
[Claim 8] A porosity aluminium phosphate (molecular sieve) is a dehumidification air conditioner according to claim 7 characterized by being the matter which a hydrated alumina and a phosphoric acid are made to react using a thermal dissociation nature template agent, and is obtained.
[Claim 9] The dehumidification air conditioner according to claim 1 to 8 characterized by heating reproduction air at 75 degrees C or less, and reproducing DESHIKANTO.
[Claim 10] The dehumidification air conditioner according to claim 9 characterized by cooling the processing air which carried out the heat exchange to the reproduction air after water adsorption in the source of the low fever of heat pump, and heating the reproduction air before DESHIKANTO reproduction in the source of high temperature of heat pump.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the dehumidification air conditioner which enabled it to regenerate continuously DESHIKANTO with the reproduction air which started the dehumidification air conditioner, especially was heated by the adsorption treatment and the source of heating of moisture by DESHIKANTO.
[0002]
[Description of the Prior Art] Drawing 16 is the conventional technology. this The processing air path A and the reproduction air path B The DESHIKANTO rotor 103, two sensible-heat exchangers 104,121, and heaters 220, Processing air is dehumidified by the DESHIKANTO rotor 103 by using a humidifier 105 as the main configuration equipment. After carrying out the heat exchange of the processing air which carried out the temperature rise to reproduction air by the 1st sensible-heat exchanger 104 and cooling with the water adsorption heat of DESHIKANTO, while humidifying with a humidifier and supplying air-conditioning space After taking in reproduction air from outer space (OA), carrying out a heat exchange to processing air and carrying out a temperature rise by the sensible-heat exchanger 104 of the above 1st, It heated by the source 200 of heating with the heater 220, relative humidity was lowered, the DESHIKANTO rotor 103 was passed, and desorption reproduction of the moisture of the DESHIKANTO rotor 103 was carried out. After carrying out the heat exchange and collecting further by the reproduction air before heating a part for the sensible heat of the reproduction air after reproduction, and the 2nd sensible-heat exchanger 121, it constituted from this conventional example so that it might emit outside (EX).
[0003] Such technology has high practical use value as technology which is called so-called DESHIKANTO air-conditioning and can control the humidity of air-conditioning space. Although it is known as DESHIKANTO used for such DESHIKANTO air-conditioning that silica gel and a zeolite will be used, it is a conversion zeolite, and is classified into Type 1 of bull NAUA, and it is known that an isothermal separation factor (separation factor) is the the best for the DESHIKANTO air-conditioning machine with which the thing of the range of 0.07-0.5 heats reproduction air by combustion gas. Moreover, under the environment of high humidity, although the lithium chloride might be used for in the past as moisture absorption matter, since there is deliquescence and there is a fault which drops out of Rota, it is no longer used gradually.
[0004]
[Problem(s) to be Solved by the Invention] in the above Prior arts, it is known for the DESHIKANTO air-conditioning machine which heats reproduction air by combustion gas that it is optimal to have 101 degrees C (215 degrees F) or the adsorption property by which an isothermal separation factor (separation factor) is shown by the adsorption isotherm of the range of 0.07-0.5 as 143 degrees C (290 degrees F) are made suitable, a zeolite is suitable as suitable DESHIKANTO for such reproduction temperature and it is shown especially in drawing 17 as for the reproduction temperature which is DESHIKANTO However, since the direction made into 65-75 degrees C has many heat sources which can be used as for reproduction temperature when it is going to use various exhaust heat and solar heat as a reproduction heat source of DESHIKANTO, although it is easy to put in practical use, in such a case, the aforementioned zeolite is not necessarily the optimal.
[0005] Drawing 17 is used for below and a reason is explained to it. Drawing 17 is the adsorption isotherm of a zeolite. When using the open air for DESHIKANTO air-conditioning as reproduction air, generally in a summer, the absolute humidity assumes kg in about 21g /by this contractor that is in charge of an air-conditioning design. If such air is heated [aforementioned] to 101 degrees C, the relative humidity will become about 3.0%. On the other hand, the relative humidity of the processing air adsorbed has the dry-bulb temperature of 27 degrees C, and the common wet-bulb temperature of 19 degrees C from the indoor conditions specified in the JIS-C9612 grade of an air conditioner, and the relative humidity at that time is about 50%. DESHIKANTO contacts between 50% of processing air, and 3.0% of processing air by turns in this way.
[0006] Reproduction air is contacted, and it considers as the constant-temperature-line separation factor R= 0.1 using the function expressed with formula X=P/(R+P-R-P), and as shown in drawing 17 , if the moisture content of the zeolite when balancing is calculated as P= 0.030 when relative humidity is 3.0%, it will be set to X= 0.236. On the other hand, the processing air from the interior of a room is contacted, and similarly, if moisture content of the zeolite when balancing is used as the constant-temperature-line separation factor R= 0.1 and is calculated as P= 0.5, it will be set to X= 0.910. Therefore, when heating reproduction air to 101 degrees C using a zeolite, in DESHIKANTO, the adsorption and desorption of the moisture of the value which multiplied 0.910-0.236=0.674 which are the difference of the relative amount of adsorption by the maximum amount of adsorption can be carried out.
[0007] When an adsorption isotherm uses a material with a linear (isothermal separation factor R= 1) property like silica gel, as well as the difference of relative humidity, the difference of the amount of adsorption and desorption is set to 0.500-0.030=0.470, and stops by 0.470 times the maximum amount of adsorption. Moreover, since a water vapor pressure cannot go up easily, the driving force of adsorption is maintained and a rate of adsorption can be made high, even if it adsorbs moisture, so that differential coefficient dP/dX which shows the ratio of variation deltaP of relative humidity to variation deltaX of the amount of adsorption and desorption is small, when a horizontal axis is set as relative humidity, a vertical axis is set as relative moisture content and it sees, the convex configuration of an adsorption isotherm is advantageous. Therefore, in this example, the zeolite is more advantageous. Thus, like 101 degrees C reproduction temperature was indicated to be in the conventional example, when high, it was advantageous

to have used a zeolite. However, if it calculates at reproduction temperature of 65-75 degrees C to which this invention targets the difference of the same adsorption and desorption, results differ.

[0008] That is, if reproduction air with an absolute humidity of 21g [/kg] is heated to 70 degrees C, the relative humidity will become 10.6%. Therefore, reproduction air is contacted, and if the moisture content of the zeolite when balancing is calculated as P= 0.106 when relative humidity is 10.6%, it will be set to X= 0.532. On the other hand, the processing air from the interior of a room is contacted, and if the moisture content of the zeolite when balancing is the same as the above and is calculated as P= 0.5, it will be set to X= 0.910. Therefore, when heating reproduction air to 70 degrees C using a zeolite, in DESHIKANTO, both difference is taken and the adsorption and desorption of one 0.378 times the moisture of 0.910-0.532=0.378, i.e., the maximum amount of adsorption, can be carried out. Moreover, the effect that the curve which connects an adsorption start point and the point of an end has small curvature in this section, does not have a linear straight line and linear great difference, and makes a rate of adsorption high hardly changes with the case of being linear.

[0009] When an adsorption isotherm uses a material with a linear (isothermal separation factor R= 1) property like silica gel, as well as the difference of relative humidity, the difference of the amount of adsorption and desorption is set to 0.5-0.106=0.394, can perform 0.394 times as much adsorption and desorption as the maximum amount of adsorption, and exceeds 0.378 of the aforementioned zeolite. Moreover, since the maximum amount of adsorption has more silica gel than a zeolite therefore, it becomes more advantageous [DESHIKANTO like the silica gel which had a near adsorption isotherm in DESHIKANTO air-conditioning with a reproduction temperature of 65-75 degrees C more nearly linearly than a zeolite], as indicated by well-known reference (for example, the practical use design of dehumidification for an air-conditioning engineer, Kyoritsu shuppan Co., Ltd., Showa 55, Chapter 4, drawing 4 .1). However, a zeolite and silica gel have a fault resulting from a common heat of adsorption. A reason is explained below.

[0010] Drawing 18 is what showed the cycle with the configuration shown in drawing 16 of DESHIKANTO air-conditioning on the psychrometric chart. Process when a drawing solid line has a large heat of adsorption is shown, and process when the heat of adsorption of a dotted line is small (close to the condensation latent heat of water) is shown. Each state of the air in drawing 16 when alphabet sign K-V has a large heat of adsorption is shown, and L' - V' shows each state of the air in drawing 16 when a heat of adsorption is small.

[0011] If drawing 18 explains processing air and reproduction air condition change, moisture is adsorbed (state L), and by the 1st sensible-heat exchanger 104, a heat exchange will be carried out to reproduction air (state Q), it will be cooled by the DESHIKANTO rotor 103 (state M), and processing air (state K) will be humidified with a humidifier 105, and will return to the air-conditioning (state P) space 101. On the other hand, reproduction air takes in the open air (state Q), by the 1st sensible-heat exchanger 104, carries out a heat exchange to processing air (state L), is heated (state R), further, the heat exchange of it is carried out, it is heated by the reproduction air after DESHIKANTO reproduction (state U), and the 2nd sensible-heat exchanger 121, (state S), is heated in a heater 220 by the source of heating (state T), and reproduces the DESHIKANTO rotor 103 after **. By the sensible-heat exchanger 121 of the above 2nd, the reproduction air (state U) which reproduced DESHIKANTO carries out a heat exchange to the reproduction air which came out of the 1st sensible-heat exchanger 104, and heat recovery is carried out (state V), and it is thrown away outside as exhaust air after **.

[0012] In DESHIKANTO air-conditioning which forms such a cycle, there is an inclination for a performance to fall, so that a heat of adsorption is large. A formula is used and explained below. When the water adsorption process on the psychrometric chart of drawing 18 (state K-L, L') has a heat of adsorption equal to the heat of condensation of water (state K-L'), the following formula consists of heat balance.
As for delta X-R=delta T-Cp, therefore this process, inclination is shown by the segment of **X / **T=Cp/R**Ci (= regularity) (it is here, and R is the condensation latent heat of water and Cp is the specific heat at constant pressure of air). On the other hand, when there is a heat of adsorption (state K-L), inclination is similarly shown by the segment of **X / **T=Cp/H**Cs (= regularity) (it is here and H is a heat of adsorption). Usually, since it is the heat-of-adsorption H> heat of condensation R, compared with process in which the adsorption process with a heat of adsorption does not have a heat of adsorption, the inclination of a segment approaches horizontally.

[0013] Here, it compares [case / where there is nothing (when larger than the heat of condensation) / the case where there is a heat of adsorption about the DESHIKANTO cycle of drawing 18 , and] about the air conditioning effect (when equal to the heat of condensation). The indoor state (state K) of processing air is made into dry-bulb temperature Tr and absolute humidity Xr, and sets the amount of dehumidification of processing air to deltaX.
Moreover, using the open air of the flow rate same to reproduction air as processing air (therefore, the amount of humidification of reproduction air also serves as deltaX), entry conditions consider as dry-bulb temperature To and absolute humidity Xo, and set reproduction temperature to Tg. These conditions are compared as the same by the case where there is nothing with the case where there is a heat of adsorption. At the adsorption dehumidification process of processing air, when there is no heat of adsorption, temperature Tl' after adsorption is Tl'= Tr+delta X/Ci.
(1) deltaX is taken as the absolute value of the humidity difference before and behind dehumidification here. This processing air carries out a heat exchange to the open air, and becomes state M'. Temperature of state M' Tm'=Tl'-epsilon(Tl'-To) =(1-epsilon) Tl'+To = (1-epsilon) +To (Tr+delta X/Ci) (2) by the case where there is nothing with the case where epsilon shows the temperature efficiency of the 1st sensible-heat exchanger here, this is the function (epsilon=f (NTU)) of NTU (the number of overall heat transmissions), and there is a heat of adsorption in this example of calculation If a flow rate, a heat transfer coefficient, and heat transfer area are equal, since NTU is equal, it is same and it can be treated as a constant.

[0014] When similarly there is a heat of adsorption Tm=Tl-epsilon (Tl-To) = (1-epsilon) [Tl+epsilon To] = (1-epsilon) +epsilonTo (Tr+delta X/Cs) (3) -- since the dry-bulb temperature of State M or M' will be [the air conditioning effect] large , if the method of a low takes the difference of Tm and Tm' in this case Tm'-Tm=(1-epsilon) (1-/Ci-1/Cs) deltaX =(1-epsilon) (Cs-Ci) deltaX/CiCs Since it is (4) Cs<Ci, it is Tm'-Tm<0, therefore it is set to Tm'<Tm, and temperature falls [the direction with few heat of adsorptions], and the air conditioning effect becomes large. That is, in drawing 18 , it is set to deltaQ'>deltaQ and the air conditioning effect becomes [the one where a heat of adsorption is larger] small.

[0015] Next, the case where there is a heat of adsorption is compared with the case where there is nothing (when larger than the heat of condensation), about the amount of necessary heating of reproduction air (when equal to the heat of condensation). When there is no heat of adsorption in drawing 18 as well as the above, state U' is Tu'=

Tg-delta X/Ci. (5) state R' is Tr'=To+epsilon(Tl'-To) =(1-epsilon) T +epsilonTl'. Since (6) state U' and state R' carry out a heat exchange, state S' is Ts'=(1-epsilon) T +epsilonTl'+ epsilon'[(Tg-delta X/Ci).
- (1-Epsilon) T -epsilonTl']
= (1-epsilon') To+epsilon' (1-epsilon) (Tg-delta X/Ci)
+ epsilon(1-epsilon')-Tl' (7) Here, epsilon' shows the temperature efficiency of the 2nd sensible-heat exchanger, and can treat it as a constant like the above. It is the state U when a heat of adsorption is large similarly. Ts=(1-epsilon') (1-epsilon) T +epsilon' (Tg-delta X/Cs)
+ epsilon(1-epsilon') Tl It is set to (8). Since there will be few amounts of reproduction heating, if the one where the dry-bulb temperature of state S' or S is higher takes the difference of Ts' and Ts in this case Ts'-Ts=-epsilon' (delta X/Ci-delta X/Cs)+epsilon (1-epsilon')
(Tl'-Tl)
= - epsilon'(delta X/Ci-delta X/Cs) +epsilon (1-epsilon')
[(Tr+delta X/Ci)- (Tr+delta X/Cs)]
= deltaX (Ci-Cs) (epsilon'-epsilon+epsilon'epsilon) / CsCi -- (9) -- since the temperature efficiency of two sensible-heat heat exchangers is usually 70% or more, and (epsilon'-epsilon+epsilon'epsilon) is positive in this range and it is Ci>Cs, (9) formulas serve as positive Therefore, since the temperature of S points becomes so high that a heat of adsorption is small, there are few amounts of heating of reproduction air, and they end. That is, in drawing 18, it is deltaG'<deltaG. Therefore, the heating value which heating of reproduction air takes increases, so that a heat of adsorption is large.

[0016] Thus, since the air conditioning effect becomes large, and the heat of adsorption of DESHIKANTO has few amounts of heating of reproduction air and ends so that it is small, although it is desirable to use DESHIKANTO with as much as possible few heat of adsorptions, as the zeolite and silica gel which are well-known DESHIKANTO are shown in the following well-known examples 1-5, the large thing is reported compared with the heat of condensation of water.

(Well-known example 1) It is indicated by drawing 17 of JP,6-277440,A that the differential heat of adsorption of a conversion zeolite is almost fixed in the practical use range [heat of condensation / of water] (amount of adsorption 0.06 - 0.2 g/g) of 1.28 times as many DESHIKANTO air-conditioning as this.

(Well-known example 2) It is indicated by Chapter 4 172 pages of reference (the practical use design of dehumidification for an air-conditioning engineer, Kyoritsu shuppan Co., Ltd., Showa 55) that a zeolite is the double precision of the heat of condensation of water.

(Well-known example 3) Having the heat of adsorption whose silica gel is 800kcal/kg in reference (air-conditioning sanitary engineering 57-volume 61 pages) is indicated. [No. 7]

(Well-known example 4) It is indicated by Chapter 4 172 pages of reference (the practical use design of dehumidification for an air-conditioning engineer, Kyoritsu shuppan Co., Ltd., Showa 55) that silica gel is 1.3 times the heat of condensation of water.

(Well-known example 5) It is indicated by reference (167 or Britain, Heat Recovery Systems, Vol.6, No.2, and pp151-1986, Fig.5) that the maximum of the differential heat of adsorption of silica gel is 1.33 times the heat of condensation of water, and the minimum value is 1.12 times the heat of condensation. Therefore, a zeolite and silica gel had the fault more than which the air conditioning effect becomes less than, and the amount of heating of reproduction air increases compared with DESHIKANTO with few heat of adsorptions.

[0017] On the other hand, as DESHIKANTO with comparatively few heat of adsorptions, there is a method using the lithium chloride infiltrated into the fiber material, and it is reported by the well-known example 6 of the following [heat of adsorption / this] that there are few heat of adsorptions.

(Well-known example 6) Since a lithium chloride has deliquescence under high humidity reference (an air-conditioning sanitary engineering handbook (Showa 42), the Society of Heating, Air-conditioning & Sanitary Engineers of Japan, Chapter 15, drawing 15, 18 concentration enthalpy diagrams), however as above-mentioned, a service condition has restrictions and it cannot be used for DESHIKANTO air-conditioning.

[0018] Moreover, although there is also a method using activated carbon as another DESHIKANTO with comparatively few heat of adsorptions Activated carbon, especially an activated carbon from wood have the property that moisture content rises rapidly from 40 - 50% of relative humidity field, as the adsorption isotherm indicated by the following well-known example 7 shown in drawing 19 shows. The sake, On the service condition of DESHIKANTO air-conditioning, there are few amounts of adsorption and desorption of moisture, differential coefficient dP/dX which shows the ratio of variation deltaP of relative humidity to variation deltaX of the amount of adsorption and desorption is large, and there was a fault to which eye a convex hatchet and a rate of adsorption become slow.

(Well-known example 7) Reference (chemical engineering collected works, the 15th volume, No. 1, 1989, pp 38-43, Fig.4)

[0019] thus, since DESHIKANTO excellent in the adsorption property has the large heat of adsorption in a Prior art, there is a fault more than which heat-energy consumption increases, DESHIKANTO with few heat of adsorptions has the fault whose adsorption property does not suit to the service condition of DESHIKANTO air-conditioning, and using DESHIKANTO in which the adsorption property which the maximum of the differential heat of adsorption is 1.1 or less times of the heat of condensation of water, and is especially shown by the adsorption isotherm has a suitable property for the reproduction temperature of 65-75 degrees C was not made

[0020]
[Problem(s) to be Solved by the Invention] this invention was made in view of the point mentioned above, and it is energy saving and it aims at offering a compact dehumidification air conditioner.

[0021]
[Means for Solving the Problem] It is what was made in order to attain the above-mentioned purpose. invention according to claim 1 After being heated by the path and the source of heating of the processing air with which moisture is adsorbed by DESHIKANTO, pass DESHIKANTO after the aforementioned water adsorption and it has the path of the reproduction air which carries out the desorption of the moisture in DESHIKANTO, and is reproduced. In the dehumidification air conditioner which has a heat exchanger between reproduction air before being heated by before the processing air by which moisture was adsorbed, and DESHIKANTO reproduction, and the source of heating The maximum of the differential heat of adsorption at the time of there being no deliquescence and adsorbing 20% or more of moisture of the maximum amount of adsorption as DESHIKANTO, is 1.1 or less times of the heat of

condensation of water. The adsorption isotherm which shows the adsorption property of DESHIKANTO and by 70% of within the limits, from 30% of relative humidity P and a constant-temperature-line separation factor are set to R for relative humidity by being set the relative amount of adsorption which makes a denominator the maximum amount of adsorption at the time of 90% of relative humidity, and defines the amount of adsorption as a molecule to X. It is the dehumidification air conditioner characterized by using DESHIKANTO which exists within limits surrounded by the X-P curve obtained as a constant-temperature-line separation factor R= 0.2, and the X-P curve obtained as a constant-temperature-line separation factor R= 2.5 using the function expressed with formula X=P/(R+P-R-P).
[0022] Thus, when there is no deliquescence and a heat of adsorption constitutes an air conditioner from conventional DESHIKANTO using DESHIKANTO which has a suitable property for the reproduction temperature of 65-75 degrees C few, it is energy saving and a compact dehumidification air conditioner can be offered.
[0023] Invention according to claim 2 is a dehumidification air conditioner according to claim 1 characterized by using an alumina bridge formation clay porous body for DESHIKANTO. Thus, by using an alumina bridge formation clay porous body for DESHIKANTO, there is no deliquescence, and DESHIKANTO which has the property for the reproduction temperature of 65-75 degrees C that it is fewer than conventional DESHIKANTO, and a heat of adsorption is suitable is obtained, it is energy saving and a compact dehumidification air conditioner can be offered.
[0024] Invention according to claim 3 is a dehumidification air conditioner according to claim 2 characterized by for the aforementioned alumina bridge formation clay porous body exchanging the convertibility cation between stratified silicate layers by the polynuclear metal hydroxyl ion containing aluminum, and carrying out heating dehydration of this. Thus, by exchanging the convertibility cation between stratified silicate layers by the polynuclear metal hydroxyl ion containing aluminum, carrying out heating dehydration of this, manufacturing an alumina bridge formation clay porous body, and using for DESHIKANTO, there is no deliquescence, and DESHIKANTO which has the property for the reproduction temperature of 65-75 degrees C that it is fewer than conventional DESHIKANTO, and a heat of adsorption is suitable is obtained, it is energy saving and a compact dehumidification air conditioner can be offered.
[0025] Invention according to claim 4 is a dehumidification air conditioner according to claim 3 characterized by a stratified silicate being nature or a synthetic smectite. Thus, the convertibility cation between stratified silicate layers is exchanged by the polynuclear metal hydroxyl ion containing aluminum using nature, such as a montmorillonite, or the synthetic smectite which has a convertibility cation as a stratified silicate. By carrying out heating dehydration of this, manufacturing an alumina bridge formation clay porous body, and using for DESHIKANTO There is no deliquescence, and DESHIKANTO which has the property for the reproduction temperature of 65-75 degrees C that it is fewer than conventional DESHIKANTO, and a heat of adsorption is suitable is obtained, it is energy saving and a compact dehumidification air conditioner can be offered.
[0026] Invention according to claim 5 is a dehumidification air conditioner according to claim 1 characterized by using structure-like activated carbon for DESHIKANTO. Thus, by using structure-like activated carbon for DESHIKANTO, there is no deliquescence, and DESHIKANTO which has the property for the reproduction temperature of 65-75 degrees C that it is fewer than conventional DESHIKANTO, and a heat of adsorption is suitable is obtained, it is energy saving and a compact dehumidification air conditioner can be offered.
[0027] Invention according to claim 6 is a dehumidification air conditioner according to claim 5 which structure-like activated carbon carries out carbonization processing of the polyvinyl formal, and is characterized by being what is obtained by carrying out activation at the temperature of 850 degrees C or less. Thus, by carrying out carbonization processing of the polyvinyl formal, carrying out activation at the temperature of 850 degrees C or less, manufacturing structure-like activated carbon, and using for DESHIKANTO, there is no deliquescence, and DESHIKANTO which has the property for the reproduction temperature of 65-75 degrees C that it is fewer than conventional DESHIKANTO, and a heat of adsorption is suitable is obtained, it is energy saving and a compact dehumidification air conditioner can be offered.
[0028] Invention according to claim 7 is a dehumidification air conditioner according to claim 1 characterized by using a porosity aluminium phosphate (molecular sieve) for DESHIKANTO. thus, the thing for which there is no deliquescence and a heat of adsorption constitutes an air conditioner from conventional DESHIKANTO, using as DESHIKANTO the aluminium phosphate (molecular sieve) which has a suitable property for the reproduction temperature of 65-75 degrees C few — energy saving — and a compact dehumidification air conditioner can be offered
[0029] Invention according to claim 8 is a dehumidification air conditioner according to claim 7 characterized by a porosity aluminium phosphate (molecular sieve) being matter which hydrated aluminas (for example, an aluminum hydroxide, a boehmite, a pseudo-boehmite, etc.) and a phosphoric acid are made to react using a thermal dissociation nature template agent (for example, an organic base like tripropylamine), and is obtained. thus, by using the manufactured porosity aluminium phosphate (molecular sieve) for DESHIKANTO, there is no deliquescence and DESHIKANTO which has the property for the reproduction temperature of 65-75 degrees C that it is fewer than conventional DESHIKANTO, and a heat of adsorption is suitable obtains — having — energy saving — and a compact dehumidification air conditioner can be offered
[0030] Invention according to claim 9 is a dehumidification air conditioner according to claim 1 to 8 characterized by heating reproduction air at 75 degrees C or less, and reproducing DESHIKANTO. Thus, a dehumidification air conditioner [************] can be offered reproducing DESHIKANTO at the reproduction temperature doubled with the adsorption property of DESHIKANTO, and by using a low drive heat source comparatively.
[0031] Invention according to claim 10 is a dehumidification air conditioner according to claim 9 characterized by cooling the processing air which carried out the heat exchange to the reproduction air after water adsorption in the source of the low fever of heat pump, and heating the reproduction air before DESHIKANTO reproduction in the source of high temperature of heat pump. Thus, by taking heat from the reproduction air after water adsorption, and using the heat for reproduction of reproduction air, multiplex use-ization of the drive energy of heat pump is attained, and a dehumidification air conditioner [************] can be offered.
[0032]
[Embodiments of the Invention] Hereafter, the example of the dehumidification air conditioner concerning this invention is explained. The 1st example of this invention is a dehumidification air conditioner using what exchanged the convertibility cation between stratified silicate layers by the polynuclear metal hydroxyl ion containing aluminum using nature, such as a montmorillonite, or the synthetic smectite which has the sodium group in a convertibility cation as a stratified silicate, carried out heating dehydration of this, and was made into the alumina bridge formation

clay porous body as DESHIKANTO. The manufacture method is introduced to the reference of the well-known example 8 of the following [method / the moisture absorption property and the manufacture method / of an alumina bridge formation clay porous body / this kind of] again also at the reference of another well-known example 9.
(Well-known example 8) Reference (the U.S., Journal of Colloid and Interface Science, Vol.134, No.1, January (1990), pp 51-58)
(Well-known example 9) Reference (5 r fr nt-fac , V l.29, and No. 1991, pp 387-398, 5.2nd term)
[0033] Drawing 1 is drawing showing the heat of adsorption of the alumina bridge formation clay porous body (Alumina Pillared Clay) indicated as Fig.10 in the reference of a well-known example 8, the horizontal axis shows the amount of adsorption and the vertical axis shows the heat of adsorption. The ratio [as opposed to / drawing 2 is what showed the heat of adsorption as a ratio to the heat of condensation of water using the relation of drawing 1 , and / as opposed to / the amount of adsorption / in a horizontal axis] the heat of condensation of the water of a heat of adsorption in a vertical axis / is shown. When the heat of adsorption of this material is 1.08 times the heat of condensation of water and the maximum of the differential heat of adsorption also averages it from drawing 2 , it turns out that it has a property almost equal to the heat of condensation of water.
[0034] Thus, the effect at the time of using DESHIKANTO which has a small heat of adsorption for the desiccant air conditioner shown in drawing 16 is explained below. When the water adsorption process on the psychrometric chart of drawing 18 (state K-L, L') has a heat of adsorption equal to the heat of condensation of water (state K-L'), the following formula consists of heat balance.
As for delta X-R=delta T-Cp, therefore this process, inclination is shown by the segment of **X / **T=Cp/R**Ci (=0.24/580=0.414x10-3= regularity). (It is here, and R is the condensation latent heat of water and Cp is the specific heat at constant pressure of air) . On the other hand, when there is a heat of adsorption (state K-L), inclination is similarly shown by the segment of **X / **T=Cp/H**Cs (= regularity) (it is here and H is a heat of adsorption). It is s t t X/**T=Cp/H**Cs=0.24/580/1.28=0.323x10-3 in using a conversion zeolite (a heat of adsorption is 1.28 times of the heat of condensation of water) for drawing 17 of JP,6-277440,A of a well-known example 1 incidentally.
[0035] Here, it compares about the air conditioning effect. The indoor state (state K) of processing air is made into dry-bulb temperature Tr and absolute humidity Xr, and sets the amount of dehumidification of processing air to deltaX. Moreover, using the open air of the flow rate same to reproduction air as processing air, entry conditions consider as dry-bulb temperature To and absolute humidity Xo, and set reproduction temperature to Tg. These conditions are compared as the same by the case where there is nothing with the case where there is a heat of adsorption. At the adsorption dehumidification process of processing air, when there is no heat of adsorption, temperature Tl' after adsorption is Tl'= Tr+delta X/Ci. (1) deltaX is the absolute value of the humidity difference before and behind dehumidification here. The absolute humidity which will reach if the point that this enthalpy line that passes along this state crosses 10% of relative humidity when reproducing at 70 degrees C and it is the dry-bulb temperature of 27 degrees C and wet-bulb temperature of 19 degrees C (relative humidity of 48%, absolute humidity of 10.7g/kg) to which indoor air conditions were specified at the JIS-C9612 grade since it can stick to DESHIKANTO to 10% of relative humidity as above-mentioned is searched for becomes in kg and about 5g /. Therefore, moisture-content deltaX dehumidified becomes in kg and 5.7g /. Therefore, it becomes Tl'=27+0.0057 / 0.000414= 40.77 degrees C. This processing air carries out a heat exchange to the open air, and becomes state M'. Temperature of state M' Tm'=Tl'-epsilon(Tl'-To) =(1-epsilon) Tl'+epsilonTo =(1-epsilon) (Tr+delta X/Ci)+epsilonTo (2) epsilon shows the temperature efficiency of the 1st sensible-heat exchanger here. Therefore, if the temperature efficiency of the 1st sensible-heat exchanger is made and an OAT is made into 30 degrees C 80%, it will become Tm'=(1-0.80)40.77+0.8x30=32.15 degree C. It means that deltaQ'= (Tl'-Tm')/Cp was obtained as an air conditioning effect since point L' before cooling was a point on the same enthalpy line as the interior of a room. Namely, deltaQ'=(40.77-32.15) x0.24=2.069kcal/kg The air conditioning effect is acquired.
[0036] When there is a heat of adsorption on the other hand Tm=Tl-epsilon (Tl-To) = (1-epsilon) [Tl+epsilon To] = (1-epsilon) +epsilonTo (Tr+delta X/Cs) (3) When the difference of Tm and Tm' is taken by State M and aforementioned M' in this case, it is. Tm'-Tm=(1-epsilon) (1-/Ci-1/Cs) deltaX = (1-epsilon) deltaX/CiCs Tm' (Cs-Ci) (4) It follows. - Tm= (1-0.80) () [0.323x10-3-0.414] x10-35.7x10-3/0.414x10-3/ 0.323x10-3 = -0.776 degrees C, therefore the air conditioning effect become small only 0.776x0.24=0.186kcal/kg, when a heat of adsorption like a zeolite is. That is, compared with the case where a heat of adsorption is equal to the heat of condensation of water, it decreases about 9%. If it puts in another way, according to this invention, the air conditioning effect will increase 10% from the case where a zeolite is used.
[0037] Next, the case where there is a heat of adsorption like a zeolite about the amount of necessary heating of reproduction air is compared with the case where there is nothing (when larger than the heat of condensation) (when equal to the heat of condensation). When there is no heat of adsorption, in drawing 18 , state U' as well as the above
Tu'= Tg-delta X/Ci = 70-0.0057 / 0.000414= 56.23 degrees C (5) state R' Tr'=To+epsilon(Tl'-To) =(1-epsilon)
T + psilonTl' =0.2x30+0.8x40.77=38.62 Since (6) state U' and state R' carry out a heat exchange, state S' is.
Ts'=(1-epsilon) To+epsilonTl'+epsilon' x [(Tg-delta X/Ci)- (1-epsilon) To-epsilon Tl']
= (1-epsilon') To+epsilon' (1-epsilon) (Tg-delta X/Ci)
+ epsilon(1-epsilon') Tl' (7) =0.2x0.2x30+0.8(70-0.0057/ 0.000414) +0.8x0.2x -- here, 40.77= 52.70 degrees C epsilon' is the temperature efficiency of the 2nd sensible-heat exchanger Therefore, amount of heating deltaG' of reproduction air is deltaG'=(Tg-Ts') xCp=(70-52.70) x0.24=4.152kcal/kg[0038]. It is the state U when a heat of adsorption is large similarly. Ts=(1-epsilon') (1-epsilon) To+epsilon' (Tg-delta X/Cs)
+ psilon(1-epsilon') Tl (8) In this case, since there will be few amounts of reproduction heating, the one where the dry-bulb temperature of state S' or S is higher is Ts' and Ts. If a difference is taken Ts'-Ts=-epsilon' (delta X/Ci-delta X/Cs)
+ psilon (1-epsilon') (Tl'-Tl)
= - epsilon'(delta X/Ci-delta X/Cs) +epsilon (1-epsilon')
[(Tr+delta X/Ci)- (Tr+delta X/Cs)]
= deltaX (Ci-Cs) (psilon '- epsilon+ psilon' psilon) / CsCi (9) =0.0057x (0.000414-0.000323)
(0.8-0.8+0.8x0.8) /0.000323/ 0.000414 The amount of heating when =2.48 **, therefore a heat of adsorption are large increases only 2.48x0.24=0.595kcal/kg. That is, it increases about 14% compared with the case where a heat of adsorption is equal to the heat of condensation of water. If it puts in another way, according to this invention, the amount of heating more nearly required than the case where a zeolite is used will decrease 13%. If energy efficiency

compares both, a difference will become large further. In the former for which coefficient of performance uses a zeolite with large COP'=deltaQ'/deltaG' =2.069 / 4.152= 0.4983 one side and heat of adsorption according to this invention, it is COP=deltaQ/deltaG=(2.069-0.186)/(4.152+0.595).
= According to 0.3967, therefore this invention, compared with the conventional example using a zeolite, coefficient of performance improves 25.6%.

[0039] The moisture absorption property of the alumina bridge formation clay porous body used for this example on the other hand is introduced to the well-known example 8, and is the the best for DESHIKANTO air-conditioning. Drawing is used and explained below. Drawing 3 is an adsorption isotherm of the material which exchanged the convertibility cation between stratified silicate (montmorillonite) layers by the polynuclear metal hydroxyl ion containing aluminum, and carried out heating dehydration of this at 200 degrees C indicated by the well-known example 8, and the relative amount of adsorption (relative moisture content) which a horizontal axis makes the amount of adsorption at the time of 90% of humidity of each DESHIKANTO as relative humidity, and a vertical axis makes it a denominator, and defines the amount of adsorption as a molecule is shown. It turns out that the relative moisture content which the relative moisture content which balances reproduction air of 10% of relative humidity heated by 70 degrees C is 0.23, and balances processing air of 50% of relative humidity from this drawing is 0.66, and the difference of adsorption and desorption is 0.43 and exceeds the above 0.378 at the time of using the zeolite of the conventional example. Moreover, it is convex, and since a water vapor pressure cannot go up easily even if differential coefficient dP/dX which shows the ratio of variation deltaP of relative humidity to variation deltaX of the amount of adsorption and desorption is small and adsorbs moisture as aforementioned, the driving force of adsorption is maintained, and the curve which connects both points can make a rate of adsorption high, and is advantageous.

[0040] Drawing 4 is an adsorption isotherm of the material which exchanged the convertibility cation between stratified silicate (montmorillonite) layers by the polynuclear metal hydroxyl ion containing aluminum, and carried out heating dehydration of this at 300 degrees C indicated by the well-known example 8, and the relative amount of adsorption (relative moisture content) which a horizontal axis makes the amount of adsorption at the time of 90% of humidity of each DESHIKANTO as relative humidity, and a vertical axis makes it a denominator, and defines the amount of adsorption as a molecule is shown. It turns out that the relative moisture content which the relative moisture content which balances reproduction air of 10% of relative humidity heated by 70 degrees C is 0.27, and balances processing air of 50% of relative humidity from this drawing is 0.73, and the difference of adsorption and desorption is 0.46 and exceeds the above 0.378 at the time of using the zeolite of the conventional example. Moreover, it is convex, and since a water vapor pressure cannot go up easily even if differential coefficient dP/dX which shows the ratio of variation deltaP of relative humidity to variation deltaX of the amount of adsorption and desorption is small and adsorbs moisture as aforementioned, the driving force of adsorption is maintained, and the curve which connects both points can make a rate of adsorption high, and is advantageous.

[0041] Drawing 5 is an adsorption isotherm of the material which exchanged the convertibility cation between stratified silicate (montmorillonite) layers by the polynuclear metal hydroxyl ion containing aluminum, and carried out heating dehydration of this at 400 degrees C indicated by the well-known example 8, and the relative amount of adsorption (relative moisture content) which a horizontal axis makes the amount of adsorption at the time of 90% of humidity of each DESHIKANTO as relative humidity, and a vertical axis makes it a denominator, and defines the amount of adsorption as a molecule is shown. It turns out that the relative moisture content which the relative moisture content which balances reproduction air of 10% of relative humidity heated by 70 degrees C is 0.18, and balances processing air of 50% of relative humidity from this drawing is 0.78, and the difference of adsorption and desorption is 0.60 and exceeds the above 0.378 at the time of using the zeolite of the conventional example. Moreover, it is convex, and since a water vapor pressure cannot go up easily even if differential coefficient dP/dX which shows the ratio of variation deltaP of relative humidity to variation deltaX of the amount of adsorption and desorption is small and adsorbs moisture as aforementioned, the driving force of adsorption is maintained, and the curve which connects both points can make a rate of adsorption high, and is advantageous.

[0042] Drawing 6 is an adsorption isotherm of the material which exchanged the convertibility cation between stratified silicate (montmorillonite) layers by the polynuclear metal hydroxyl ion containing aluminum, and carried out heating dehydration of this at 600 degrees C indicated by the well-known example 8, and the relative amount of adsorption (relative moisture content) which a horizontal axis makes the amount of adsorption at the time of 90% of humidity of each DESHIKANTO as relative humidity, and a vertical axis makes it a denominator, and defines the amount of adsorption as a molecule is shown. It turns out that the relative moisture content which the relative moisture content which balances reproduction air of 10% of relative humidity heated by 70 degrees C is 0.19, and balances processing air of 50% of relative humidity from this drawing is 0.73, and the difference of adsorption and desorption is 0.54 and exceeds the above 0.378 at the time of using the zeolite of the conventional example. Moreover, it is almost convex, and since a water vapor pressure cannot go up easily even if differential coefficient dP/dX which shows the ratio of variation deltaP of relative humidity to variation deltaX of the amount of adsorption and desorption is small and adsorbs moisture as aforementioned, the driving force of adsorption is maintained, and the curve which connects both points can make a rate of adsorption high, and is advantageous.

[0043] Drawing 7 is data which are indicated by the well-known example 8 and which measured the adsorption isotherm of the material which exchanged the convertibility cation between stratified silicate (montmorillonite) layers by the polynuclear metal hydroxyl ion containing aluminum, and carried out heating dehydration of this at 300 degrees C at the time of desorption, and the relative amount of adsorption (relative moisture content) which a horizontal axis makes the amount of adsorption at the time of 90% of humidity of each DESHIKANTO as relative humidity, and a vertical axis makes it a denominator, and defines the amount of adsorption as a molecule is shown. It turns out that the relative moisture content which the relative moisture content which balances reproduction air of 10% of relative humidity heated by 70 degrees C is 0.25, and balances processing air of 50% of relative humidity from this drawing is 0.82, and the difference of adsorption and desorption is 0.57 and exceeds the above 0.378 at the time of using the zeolite of the conventional example. Moreover, it is convex, and since a water vapor pressure cannot go up easily even if differential coefficient dP/dX which shows the ratio of variation deltaP of relative humidity to variation deltaX of the amount of adsorption and desorption is small and adsorbs moisture as aforementioned, the driving force of adsorption is maintained, and the curve which connects both points can make a rate of adsorption high, and is advantageous.

[0044] As shown in aforementioned drawing 3 - drawing 7, since it has the property that it cannot be based on the

processing temperature of heating dehydration, but the large difference of adsorption and desorption can be taken, and a rate of adsorption can moreover be maintained highly and DESHIKANTO of this example can perform many moisture processings in few DESHIKANTO in DESHIKANTO air-conditioning, it can be managed with a compact DESHIKANTO rotor, therefore can make an air conditioner compact. Thus, by using as DESHIKANTO the thing which is the 1st example and which exchanged the convertibility cation between stratified silicate layers by the polynuclear metal hydroxyl ion containing aluminum using the montmorillonite which has the sodium group in a convertibility cation as a stratified silicate, carried out heating dehydration of this, and was made into the alumina bridge-formation clay porous body, compared with the conventional example, the air conditioning effect is large, it excels in energy saving, and a compact air conditioner can offer.
[0045] In addition, although the convertibility cation between layers was exchanged by the polynuclear metal hydroxyl ion containing aluminum, using a montmorillonite as a stratified silicate and this was shown by this example as an example using the alumina bridge formation clay porous body which carried out heating dehydration as DESHIKANTO As a clay mineral which has the 2:1 type layer structure of not only a montmorillonite but analogous bloating tendency as a stratified silicate The convertibility cation between stratified silicate layers is exchanged by the polynuclear metal hydroxyl ion containing aluminum using nature, such as a hectorite, a beidellite, and a saponite, or a synthetic smectite. It does not interfere, even if it uses as DESHIKANTO what carried out heating dehydration of this and was made into the alumina bridge formation clay porous body.
[0046] The 2nd example of this invention is a dehumidification air conditioner using the structure-like activated carbon (SAC) obtained by carrying out carbonization processing of the polyvinyl formal, and carrying out activation at the temperature of 850 degrees C or less as DESHIKANTO. The manufacture method is introduced to the reference of the well-known example 10 of the following [method / the moisture absorption property and the manufacture method / of structure-like activated carbon / this kind of] again also at the reference of another well-known example 11.
(Well-known example 10) Reference (chemical engineering collected works, the 15th volume, No. 1, 1989, pp 38-43)
(Well-known example 11) If the heat of adsorption of this material is averaged to 40 pages of the reference of the reference (chemical engineering collected-works, 10th volume, No. 5, 1984, pp 574-579) well-known example 10, it is indicated by them that it is about 1.02 times the heat of condensation of water. Therefore, inclination is set to **X/**T**Ci=0.24/580/1.02=0.406x10-3 by the process of water adsorption process like the 1st example of the above. On the other hand, in using a conversion zeolite (a heat of adsorption is 1.28 times of the heat of condensation of water) for drawing 17 of JP,6-277440,A of a well-known example 1, it is set to X/**T=Cp/H**Cs=0.24/580/1.28=0.323x10-3 like the 1st example of the above.
[0047] Here, it compares about the air conditioning effect. It calculates on the same conditions as the 1st example of the above, and moisture-content deltaX dehumidified is carried out in 5.7g/kg. Therefore, it becomes Tl'=27+0.0057 / 0.000406= 41.04 degrees C. This processing air carries out a heat exchange to the open air, and becomes state M'. The temperature of state M' becomes Tm'=(1-0.80)41.04+0.8x30=32.21 degree C from a formula (2). Since there is some heat of adsorption in this example in calculation of the air conditioning effect, and there is no state L' on the same enthalpy line as indoor air, using the temperature of state L' of the 1st example of the above, it calculates, namely, the deltaQ'=(40.77-32.21) x0.24=2.054kcal/kg air conditioning effect is acquired. On the other hand, when there is a heat of adsorption, with reference to the 1st example, the deltaQ=2.069-0.186=1.883kcal/kg air conditioning effect is acquired. it follows and decreases about 8% compared with the case where the heat of condensation of water has the 1.02-time air conditioning effect as for a heat of adsorption If it puts in another way, according to this invention, the air conditioning effect will increase 9% from the case where a zeolite is used.
[0048] Next, about the amount of necessary heating of reproduction air, the case where it is a zeolite with a large heat of adsorption is compared with the case where it is a small (when it is 1.28 times the heat of condensation) this example (when it is 1.02 times the heat of condensation). It sets to drawing 18 as well as the above. when a heat of adsorption is small state U' -- Tu from the aforementioned (5) formula -- '= Tg-delta X/Ci=70-0.0057 / 0.000406= 55.96-degree-C state R' -- Tr from (6) formulas -- '= To+epsilon (Tl'-To) = (1-epsilon) To+epsilon Tl' -- since =0.2x30+0.8x41.04= 38.83-degree-C state U' and state R' carry out a heat exchange -- Ts from state S' and (7) formulas -- '= (1-epsilon') (1-epsilon) To+epsilon' (Tg-delta X/Ci)
+ epsilon(1-epsilon') Tl' =0.2x0.2x30+0.8(70-0.0057/ 0.000406)+0.8x0.2x41.04=52.54 degree C, therefore amount of heating deltaG' of reproduction air are deltaG'=(Tg-Ts') xCp=(70-52.54) x0.24=4.190kcal/kg[0049]. A heat of adsorption increases similarly the amount of heating in case amount of heating deltaG when a heat of adsorption is large is the zeolite with which the heat of condensation of water has a 1.28-time heat of adsorption since it is deltaG=4.152+0.595=4.747kcal/kg with reference to the 1st example therefore by about 13% compared with this example which is 1.02 times the heat of condensation of water. If it puts in another way, according to this invention, the amount of heating more nearly required than the case where a zeolite is used will decrease 12%. If energy efficiency compares both, a difference will become large further. According to this invention, in the former for which coefficient of performance uses a zeolite with large COP'=deltaQ'/deltaG' =2.054 / 4.190= 0.4902 one side and heat of adsorption, with reference to the 1st example, coefficient of performance improves 23.6% rather than the conventional example using a zeolite according to COP=delta Q/delta G= 0.3967, therefore this invention.
[0050] The moisture absorption property of the structure-like activated carbon (SAC) used for this example on the other hand is introduced to the well-known example 10, and is the the best for DESHIKANTO air-conditioning. Drawing is used and explained below. It is the adsorption isotherm of the material obtained in structure-like activated carbon (SAC) by carrying out low activation (Activation) at 800 degrees C for 1.5 hours drawing 8 is indicated to be by the well-known example 10, and the relative amount of adsorption (relative moisture content) which a horizontal axis makes the amount of adsorption at the time of 90% of humidity of each DESHIKANTO as relative humidity, and a vertical axis makes it a denominator, and defines the amount of adsorption as a molecule is shown. Moreover, a whit round head expresses a desorption property and a black dot expresses an adsorption property. It turns out that the relative moisture content which the relative moisture content which balances reproduction air of 10% of relative humidity heated by 70 degrees C is 0.04, and balances processing air of 50% of relative humidity from this drawing is 0.70-0.75, and the differences of adsorption and desorption are 0.66-0.71, and exceed the above 0.378 at the time of using the zeolite of the conventional example far and are advantageous. There is still more maximum amount of adsorption of this material as 40%, and since more [as compared with the maximum amount of adsorption (23%) of the zeolite (4A) indicated by the well-known example 12 / 1.7 times], it is much more advantageous. Moreover, although

the curve which connects both points is serpentine [loose], since it can approximate as an almost linear property, the same adsorption driving force as silica gel is obtained, and a performance improves more sharply than the conventional activated carbon from wood.
(Well-known example 12) It is indicated by Chapter 4 152 page drawing 4 .1b of reference (the practical use design of dehumidification for an air-conditioning engineer, Kyoritsu shuppan Co., Ltd., Showa 55) that the amount of the maximum water adsorption of zeolite 4A is 23%.
[0051] It is the adsorption isotherm of the material obtained in structure-like activated carbon (SAC) by carrying out low activation (Activation) at 850 degrees C for 1 hour drawing 9 is indicated to be by the well-known example 10, and the relative amount of adsorption (relative moisture content) which a horizontal axis makes the amount of adsorption at the time of 90% of humidity of each DESHIKANTO as relative humidity, and a vertical axis makes it a denominator, and defines the amount of adsorption as a molecule is shown. Moreover, a white round head expresses a desorption property and a black dot expresses an adsorption property. It turns out that the relative moisture content which the relative moisture content which balances reproduction air of 10% of relative humidity heated by 70 degrees C is 0.03, and balances processing air of 50% of relative humidity from this drawing is 0.77-0.79, and the differences of adsorption and desorption are 0.74-0.76, and exceed the above 0.378 at the time of using the zeolite of the conventional example far and are advantageous. There is still more maximum amount of adsorption of this material as 30%, and since more [as compared with the maximum amount of adsorption (23%) of the zeolite (4A) indicated by the well-known example 12 / 1.7 times], it is much more advantageous. Moreover, although the curve which connects both points is serpentine [loose], since it can approximate as an almost linear property, the same adsorption driving force as silica gel is obtained, and a performance improves more sharply than the conventional activated carbon from wood.
[0052] Drawing 10 is the adsorption isotherm of the material before carrying out activation (Activation) of the structure-like activated carbon (SAC) indicated by the well-known example 10, and the relative amount of adsorption (relative moisture content) which a horizontal axis makes the amount of adsorption at the time of 90% of humidity of each DESHIKANTO as relative humidity, and a vertical axis makes it a denominator, and defines the amount of adsorption as a molecule is shown. It turns out that the relative moisture content which the moisture content which balances reproduction air of 10% of relative humidity heated by 70 degrees C is 0.03, and balances processing air of 50% of relative humidity from this drawing is 0.70, and the difference of adsorption and desorption is 0.67, and exceeds the above 0.378 at the time of using the zeolite of the conventional example far and is advantageous. Although the maximum amount of adsorption of this material is furthermore 20%, as for profitableness, the material since it is practically equal, before comparing with the maximum amount of adsorption (23%) of the zeolite (4A) indicated by the well-known example 12, and carrying out activation (Activation) is also maintained.
[0053] As shown in aforementioned drawing 8 - drawing 10 , since it has the property that it cannot be based on the temperature which will carry out activation if DESHIKANTO of this example is 850 degrees C or less in activation (Activation) temperature, but the large difference of adsorption and desorption can be taken, and a rate of adsorption can moreover be maintained highly, and many moisture processings can be performed in few DESHIKANTO in DESHIKANTO air-conditioning, it ends with a compact DESHIKANTO rotor, therefore an air conditioner can be made compact. Thus, by using as DESHIKANTO the structure-like activated carbon (SAC) which is the 2nd example and which carries out carbonization processing of the polyvinyl formal, and is obtained by carrying out activation at the temperature of 850 degrees C or less, compared with the conventional example, the air conditioning effect is large, it excels in energy saving, and a compact air conditioner can be offered.
[0054] Drawing 11 is what displayed collectively the adsorption isotherm of the DESHIKANTO material shown in drawing 3 -10, and the relative amount of adsorption (relative moisture content) which a horizontal axis makes the amount of adsorption at the time of 90% of humidity of each DESHIKANTO as relative humidity, and a vertical axis makes it a denominator, and defines the amount of adsorption as a molecule is shown. DESHIKANTO of this invention exists within limits surrounded by the X-P curve obtained as a constant-temperature-line separation factor R= 0.2, and the X-P curve obtained as a constant-temperature-line separation factor R= 2.5 using the function which all sets P and a constant-temperature-line separation factor to R for relative humidity by setting the relative amount of adsorption to X in 30 to 70% of range as shown in this drawing, and is expressed with formula X=P/(R+P-R-P). [of relative humidity] If the difference of the adsorption and desorption in the case of the constant-temperature-line separation factor R= 0.2 which is the adsorption property of imagination is searched for here using the aforementioned function The moisture content which balances reproduction air of 10% of relative humidity heated by 70 degrees C Since the relative moisture content which is 0.357 and balances processing air of 50% of relative humidity is 0.833, the difference of moisture adsorption and desorption is 0.476, and exceeds the above 0.378 at the time of using the zeolite of the conventional example far and is advantageous.
[0055] next, as similar DESHIKANTO with an effect common to the 1st example and the 2nd example, as indicated to the claim 1 of this invention, the maximum of the differential heat of adsorption shows the example of calculation, and explains the effect of DESHIKANTO which is 1.1 or less twice the heat of condensation of water When a heat of adsorption is the highest, as for this calculation, the average of a heat of adsorption performs [******] comparison with the zeolite of a well-known example 1 supposing 1.1 times as much DESHIKANTO as the heat of condensation of water. Inclination is set to **X/**T**Ci=0.24/580/1.1=0.376x10-3 by the process of water adsorption process like the 1st example of the above. On the other hand, in using a conversion zeolite (a heat of adsorption is 1.28 times of the heat of condensation of water) for drawing 17 of JP,6-277440,A of a well-known example 1, it is set to X/**T=Cp/H**Cs=0.24/580/1.28=0.323x10-3 like the 1st example of the above.
[0056] Here, it compares about the air conditioning effect. It calculates on the same conditions as the 1st example of the above, and moisture-content deltaX dehumidified is carried out in 5.7g/kg. Therefore, it becomes Tl'=27+0.0057 / 0.000376= 42.16 degrees C. This processing air carries out a heat exchange to the open air, and becomes state M'. The temperature of state M' becomes Tm'=(1-0.80)42.16+0.8x30=32.43 degree C from a formula (2). Since there is some heat of adsorption in this example in calculation of the air conditioning effect, and there is no state L' on the same enthalpy line as indoor air, using the temperature of state L' of the 1st example of the above, it calculates, namely, the deltaQ'=(40.77-32.43) x0.24=2.002kcal/kg air conditioning effect is acquired. On the other hand, when there is a heat of adsorption, with reference to the 1st example, the deltaQ=2.069-0.186=1.883kcal/kg air conditioning effect is acquired. it follows and decreases about 6% compared with the case where the heat of condensation of water has the 1.1-time air conditioning effect as for a heat of adsorption If it puts in another way, according to this

invention, the air conditioning effect will increase 6% from the case where a zeolite is used.
[0057] Next, about the amount of necessary heating of reproduction air, the case where it is a zeolite with a large heat of adsorption is compared with the case where it is a small (when it is 1.28 times the heat of condensation) this example (when it is 1.1 times the heat of condensation). It sets to drawing 18 as well as the above. when a heat of adsorption is small state U' — Tu from the aforementioned (5) formula — '= Tg-delta x/Ci=70-0.0057 / 0.000376= 54.84-degree-C state R' — Tr from (6) formulas — '= To+epsilon (Tl'-To) = (1-epsilon) To+ epsilon Tl' — since =0.2x30+0.8x42.16= 39.73-degree -C state U' and state R' carry out a heat exchange — Ts from state S' and (7) formulas — '= (1-epsilon') (1-epsilon) T +epsilon' (Tg-delta X/Ci)
+ epsilon (1-epsilon') Tl' =0.2x0.2x30+0.8(70-0.0057/ 0.000376)+0.8x0.2x42.16=51.82 degree C, therefore amount of heating deltaG' of reproduction air are deltaG'=(Tg-Ts') x Cp=(70-51.82) x0.24=4.363. kcal/kg [0058] A heat of adsorption increases similarly the amount of heating in case amount of heating deltaG when a heat of adsorption is large is the zeolite with which the heat of condensation of water has a 1.28-time heat of adsorption since it is deltaG=4.152+0.595=4.747kcal/kg with reference to the 1st example therefore by about 9% compared with this example which is 1.1 times the heat of condensation of water. If it puts in another way, according to this invention, the amount of heating more nearly required than the case where a zeolite is used will decrease 8%. If energy efficiency compares both, a difference will become large further. In the former for which coefficient of performance uses a zeolite with large COP'=deltaQ'/deltaG' =2.002 / 4.363= 0.4589 one side and heat of adsorption, according to COP=delta Q/delta G= 0.3967, therefore this invention, with reference to the 1st example, coefficient of performance improves 15.7% according to this invention. Thus, as indicated to the claim 1 of this invention, by using DESHIKANTO whose maximum of the differential heat of adsorption is 1.1 or less times of the heat of condensation of water, the air conditioning effect increases sharply and the high energy-saving effect is acquired. The 3rd example of this invention is a dehumidification air conditioner using the porosity aluminium phosphate (the common name AlPO 4-5 in a molecular sieve, for example, a union carbide company, and a society) which hydrated aluminas (for example, an aluminum hydroxide, a boehmite, a pseudo-boehmite, etc.) and a phosphoric acid are made to react using the template agent (for example, an organic base like tripropylamine) of thermal dissociation nature, and is obtained as indicated by the following well-known example 13 as DESHIKANTO. Artificers compounded this porosity aluminium phosphate (a molecular sieve, a common name AlPO 4-5), measured the heat of adsorption and adsorption property, and obtained the following result.
(Well-known example 13) The name classification of this kind of porosity aluminium phosphate (molecular sieve) is indicated by reference (-1147 or Journal of American Chemical Society.Vol.104 and pp.1146 1982) as a title "Aluminophosphate Molecular Sieves:A New Class of Microporous Crystalline Inorganic Solid."
[0059] Drawing 12 is measured drawing in which showing the heat of adsorption of a porosity aluminium phosphate (molecular sieve), the horizontal axis shows the amount of adsorption and the vertical axis shows the heat of adsorption. The ratio [as opposed to / drawing 13 is what showed the heat of adsorption at the time of adsorbing 20% or more of moisture of the maximum amount of adsorption using the relation of drawing 12 as a ratio to the heat of condensation of water, and / as opposed to / the amount of adsorption / in a horizontal axis] the heat of condensation of the water of a heat of adsorption in a vertical axis / is shown. When the heat of adsorption of this material is 0.97 to 1.08 times the heat of condensation of water and the differential heat of adsorption averages it from drawing 13 , it turns out that it is about 1.05 times the heat of condensation of water.
[0060] Thus, the effect at the time of using DESHIKANTO which has a small heat of adsorption for the desiccant air conditioner shown in drawing 5 is explained below. When the water adsorption process on the psychrometric chart of drawing 7 (state K-L, L') has a heat of adsorption as small as 1.05 times of the heat of condensation of water (state K-L'), the following formula consists of heat balance.
As for deltaX and (Rx1.05) =deltaT-Cp, therefore this process, inclination is shown by the segment of **X/**T=Cp/R/1.05**Ci (=0.24/580/1.05=0.394x10-3= regularity) (it is here and, for R, the condensation latent heat of water and Cp are the specific heat at constant pressure of air).
[0061] On the other hand, when a heat of adsorption is large to a further (state K-L), inclination is similarly shown by the segment of **X / **T=Cp/H**Cs (= regularity) (it is here and H is a heat of adsorption). When a conversion zeolite (zeolite whose heat of adsorption is 1.28 times the heat of condensation of water) is incidentally used for drawing 17 of JP,6-277440,A of a well-known example 1 X/**T=Cp/H**Cs=0.24/580/1.28 = it is set to 0.323x10-3.
[0062] Here, it compares about the air conditioning effect. The indoor state (state K) of processing air is made into dry-bulb temperature Tr and absolute humidity Xr, and sets the amount of dehumidification of processing air to deltaX. Moreover, using the open air of the flow rate same to reproduction air as processing air, entry conditions consider as dry-bulb temperature To and absolute humidity Xo, and set reproduction temperature to Tg. These conditions are compared as the same by the case where there is nothing with the case where there is a heat of adsorption. At the adsorption dehumidification process of processing air, when a heat of adsorption is as small as 1.05 times, temperature Tl' after adsorption is Tl'= Tr+delta X/Ci. (1) [0063] deltaX is the absolute value of the humidity difference before and behind dehumidification here. The absolute humidity which will reach if the point that the line of inclination X/**T=0.394x10-3 which pass along this state crosses 10% of relative humidity when reproducing at 70 degrees C and it is the dry-bulb temperature of 27 degrees C and wet-bulb temperature of 19 degrees C (relative humidity of 48%, absolute humidity of 10.7g/kg) to which indoor air conditions were specified at the JIS-C9612 grade since it can stick to DESHIKANTO to 10% of relative humidity as above-mentioned be searched for becomes in kg and about 5g /. Therefore, moisture-content deltaX dehumidified becomes in kg and 5.7g /. Therefore, it becomes Tl'=27+0.0057 / 0.000394= 41.47 degrees C.
[0064] This processing air carries out a heat exchange to the open air, and becomes state M'. Temperature of state M' Tm'=Tl'- epsilon(Tl'-To) =(1-epsilon) Tl'+ epsilonTo =(1- epsilon) (Tr+delta X/Ci)+epsilonTo (2) epsilon shows the temperature efficiency of the 1st sensible-heat exchanger here. Therefore, if the temperature efficiency of the 1st sensible-heat exchanger is made and an OAT is made into 30 degrees C 80%, it will become Tm'=(1-0.80)41.47+0.8x30=32.29 degree C. Point L' before cooling is in an elevated-temperature side rather than the point on the same enthalpy line as the interior of a room, and since the temperature of the point on the same enthalpy line as the interior of a room is 41.47-0.0057/0.000394x(1.05-1.00) =40.77 degree C, namely, when using a molecular sieve, the deltaQ'=(40.77-32.29) x0.24=2.035kcal/kg air conditioning effect is acquired as an air conditioning effect.
[0065] When a heat of adsorption is large on the other hand Tm=Tl-epsilon (Tl-To) = (1- epsilon) [Tl+ epsilon To] = (1-epsilon) +epsilonTo (Tr+delta X/Cs) (3) When the difference of Tm and Tm' is taken by State M and

aforementioned M' in this case , it is. Tm'-Tm=(1-epsilon) (1-/Ci-1/Cs) deltaX = (1-epsilon) deltaX/CiCs Tm' (Cs-Ci) When (4), therefore a zeolite are used - Tm= (1-0.80) () [0.323x10-3-0.394] x10-35.7x10-3 / 0.394x10-3 /0.323x10-3 =-0.636 **, therefore the air conditioning effect -- a zeolite -- like -- case a heat of adsorption is large -- 0.636 x0.24=0.153kcal/kg only -- it becomes smaller than the case where a molecular sieve is used That is, compared with the case where the molecular sieve of this invention is used, it decreases about 7.5%. If it puts in another way, according to this invention, the air conditioning effect will increase 8.1% from the case where a zeolite is used.

[0066] Next, the case where a heat of adsorption is small is compared with the case where a heat of adsorption is large, like a molecular sieve like a zeolite about the amount of necessary heating of reproduction air (when the heat of condensation is equal 1.05 times). (when it is 1.28 times the heat of condensation) It sets to drawing 7 as well as the above . when a heat of adsorption is small, state U' Tu'= Tg-delta X/Ci=70-0.0057/0.000394 = 55.53 degrees C (5) state R' Tr'=To+epsilon(Tl'-To) =(1-epsilon) To+epsilonTl' =0.2x30+0.8x41.47=39.18 Since (6) state U' and state R' carry out a heat exchange, state S' is Ts'=(1-epsilon) To+epsilonTl'+epsilon'[(Tg-delta X/Ci).
- (1-Epsilon) To-epsilonTl']
= (1-epsilon') To+epsilon' (1-epsilon) (Tg-delta X/Ci)
+ epsilon(1-epsilon') Tl' (7) = 0.2x0.2x30+0.8 (70-0.0057 /0.000394)+0.8x0.2x41.47 = here, 52.26 degrees C epsilon' is the temperature efficiency of the 2nd sensible-heat exchanger.

[0067] Therefore, amount of heating deltaG' of reproduction air deltaG'=(Tg-Ts') xCp=(70-52.26) x0.24 = it is the stat U when a heat of adsorption is large (when it is 1.28 times the heat of condensation) similarly [kcal / 4.258 //kg].
Ts=(1-epsilon') (1-epsilon) To+epsilon' (Tg-delta X/Cs)
+ psilon(1-epsilon') Tl -- (8) -- since there will be few amounts of reproduction heating, if the one where the dry-bulb temperature of state S' or S is higher takes the difference of Ts' and Ts in this case -- Ts' -Ts=-psilon'(delta X/Ci-delta X/Cs) +epsilon (1-epsilon')
(Tl'-Tl)
= - psilon'(delta X/Ci-delta X/Cs) +epsilon (1-epsilon')
[(Tr+delta X/Ci)- (Tr+delta X/Cs)]
= deltaX (Ci-Cs) (epsilon'-epsilon+epsilon'epsilon) / CsCi (9) =0.0057x (0.000394-0.000323)
x (0.8-0.8+0.8x0.8)/0.000323 /0.000394 the amount of heating when =2.04 degree C, therefore a heat of adsorption are large -- 2.04x0.24=0.490kcal/kg only -- it increases That is, it increases about 11.5% compared with the case where the heat of condensation of water has an equal heat of adsorption 1.05 times. If it puts in another way, according to this invention, the amount of heating more nearly required than the case where a zeolite is used will decrease 10.3%.

[0068] If energy efficiency compares both, a difference will become large further. According to this invention, in the former for which coefficient of performance uses a zeolite with large COP'=deltaQ'/deltaG' =2.035 / 4.258= 0.4779 one side and heat of adsorption, compared with the conventional example using a zeolite, coefficient of performance improves 20.6% according to COP=delta Q/delta G=(2.035-0.153)/(4.258+0.490) =0.3964, therefore this invention.

[0069] On the other hand, the moisture absorption property of the porosity aluminium phosphate (molecular sieve) used for this example is also checking that it is the the best for DESHIKANTO air-conditioning by an artificer's measurement. Drawing is used and explained below. the hydrated alumina (for example, an aluminum hydroxide --) to which the artificer measured drawing 14 the porosity aluminium phosphate (a molecular sieve --) which a boehmite, a pseudo-boehmite, etc. and a phosphoric acid are made to react using the template agent (for example, an organic base like tripropylamine) of thermal dissociation nature, and is obtained For example, it is the adsorption isotherm of the common name AlPO 4-5 in a union carbide company and a society, and the relative amount of adsorption (relative moisture content) which a horizontal axis makes the amount of adsorption at the time of 90% of humidity of each DESHIKANTO as relative humidity, and a vertical axis makes it a denominator, and defines the amount of adsorption as a molecule is shown. It turns out that the relative moisture content which the relative moisture content which balances reproduction air of 10% of relative humidity heated by 70 degrees C is 0.05, and balances processing air of 50% of relative humidity from this drawing is 0.81, and the difference of adsorption and desorption is 0.76 and far exceeds the above 0.378 at the time of using the zeolite of the conventional example. Moreover, it is convex, and since a water vapor pressure cannot go up easily even if differential coefficient dP/dX which shows the ratio of variation deltaP of relative humidity to variation deltaX of the amount of adsorption and desorption is small and adsorbs moisture as aforementioned, the driving force of adsorption is maintained, and the curve applied to especially 50% from 20% of relative humidity can make a rate of adsorption high, and is advantageous. Moreover, the heat of adsorption generated in case moisture is adsorbed is a book, if a heat of adsorption is low in 0.20 or more fields in the use of this invention, 20% or more, i.e., the relative moisture content, of the maximum amount of adsorption, although a bird clapper is very greatly common when moisture content is extremely small.

[0070] Thus, since it has the property that the processing temperature of heating dehydration can take the large difference of adsorption and desorption also by the low case, and a rate of adsorption can moreover be maintained highly and DESHIKANTO of this example can perform many moisture processings in few DESHIKANTO in DESHIKANTO air-conditioning, it can be managed with a compact DESHIKANTO rotor, therefore can make an air conditioner compact. Thus, by using as DESHIKANTO the porosity aluminium phosphate (the common name AlPO 4-5 in a molecular sieve, for example, a union carbide company, and a society) which hydrated aluminas (for example, an aluminum hydroxide, a boehmite, a pseudo-boehmite, etc.) and a phosphoric acid are made to react using the template agent (for example, an organic base like tripropylamine) of thermal dissociation nature, and is obtained, compared with the conventional example, the air conditioning effect is large, it excels in energy saving, and a compact air conditioner can be offered.

[0071] Drawing 15 is the desiccant air conditioner of the so-called hybrid type which are other examples of this invention and combined a desiccant air conditioner as shown in drawing 16 , and heat pump, and is a dehumidification air conditioner characterized by cooling the processing air which carried out the heat exchange to the reproduction air after water adsorption in the source of the low fever of heat pump, and heating the reproduction air before DESHIKANTO reproduction in the source of high temperature of heat pump, and reproducing DESHIKANTO. According to this kind of hybrid form desiccant air conditioner, an air conditioner [************ / still] can be offered. With reference to a drawing, it explains below.

[0072] The example of drawing 15 The processing air path A, the reproduction air path B, and the DESHIKANTO rotor

103, Two sensible-heat exchangers 104,121 and the heater 220 by the source of high temperature of heat pump (condenser). The condensator (evaporator) 240 by the source of the low fever, and the compressor 260 of heat pump. Processing air is dehumidified by the DESHIKANTO rotor 103 by using a humidifier 105 as the main configuration equipment. After carrying out the heat exchange of the processing air which carried out the temperature rise to reproduction air by the 1st sensible-heat exchanger 104, cooling with the water adsorption heat of DESHIKANTO and cooling it with a condensator 240 further, while humidifying with a humidifier and supplying air-conditioning space After taking in reproduction air from outer space (OA), carrying out a heat exchange to processing air by the sensible-heat exchanger 104 of the above 1st, carrying out a heat exchange to the reproduction air after DESHIKANTO reproduction and carrying out a temperature rise by the 2nd sensible-heat exchanger 121 further, Heat by the heat of condensation of heat pump with a heater 220, and relative humidity is lowered. After passing the DESHIKANTO rotor 103, carrying out desorption reproduction of the moisture of the DESHIKANTO rotor 103 and carrying out a heat exchange to the reproduction air before heating the reproduction air after reproduction by the 2nd sensible-heat exchanger 121 further, it constitutes so that it may emit outside (EX).

[0073] Since it is only differing in that the cooling operation by the condensator 240 joined the conventional example of drawing 16 about the operation, detailed explanation is omitted and explains the energy-saving effect below. Here, suppose that what exchanged the convertibility cation between stratified silicate layers for the DESHIKANTO rotor 103 by the polynuclear metal hydroxyl ion containing aluminum using the montmorillonite which has the sodium group in a convertibility cation as the same stratified silicate as the 1st example, carried out heating dehydration of this, and was made into the alumina bridge formation clay porous body is used. That is, the heat of adsorption of this DESHIKANTO is equal to the heat of condensation of water.

[0074] If, as for the heat pump used for this kind of hybrid DESHIKANTO air-conditioning machine, an applicant heats reproduction air temperature to 70 degrees C using the method indicated as Japanese Patent Application No. 9-90242, 15 degrees C will be needed, as for evaporating temperature, about 65 degrees C will be needed, as for a condensation temperature, and a temperature lift will become 50 degrees C. Therefore, the coefficient of performance (COP) usually obtained is about 3.0. Therefore, if input energy of a compressor is set to 1, the heat of 4.0 will be emitted in a heater 220. Since amount of heating deltaG' of S' of drawing 18 - T is deltaG'=(40.77-32.15) x0.24=2.069kcal/kg in the 1st example of the above, with the condensator 240 of drawing 15 , it is q=deltaG'xCOP/(COP+1).
= 4.152x3.0 / 4.0= 3.114kcal [/kg] cooling effect is acquired. The temperature of the processing air after cooling is Tm'-q/Cp=32.15-3.114 / 0.24= 19.18 degrees C (it is more than evaporating temperature). Therefore, the comprehensive air conditioning effect is set to deltaQ'+q=2.069+3.114=5.183kcal/kg. On the other hand, since the drive energy of heat pump is W=delta G'/(COP+1) =4.152 / 4= 1.038kcal/kg, the synthesis COP of this air conditioner is set to COP= (deltaQ'+q) / W= 5.183 / 1.038= 4.993. Usually, since COP of the air conditioner using the steamy compression equation refrigerating cycle for general air-conditioning is about three, according to this example, 40% of energy-saving effect is acquired.

[0075] Next, suppose that the porosity aluminium phosphate (the common name AlPO 4-5 in a molecular sieve, for example, a union carbide company, and a society) which the 3rd same hydrated aluminas (for example, an aluminum hydroxide, a boehmite, a pseudo-boehmite, etc.) and same phosphoric acid as an example are made to react using the template agent (for example, an organic base like tripropylamine) of thermal dissociation nature as a DESHIKANTO rotor 103, and is obtained is used. That is, the heat of adsorption of this DESHIKANTO is equal 1.05 times of the heat of condensation of water as aforementioned.

[0076] The method which these people indicated as Japanese Patent Application No. 9-90242 is used for heat pump like a previous example. If reproduction air temperature is heated to 70 degrees C, 15 degrees C will be needed, as for evaporating temperature, about 65 degrees C will be needed, as for a condensation temperature, and a temperature lift will become 50 degrees C. Therefore, the coefficient of performance (COP) usually obtained is about 3.0. Therefore, if input energy of a compressor is set to 1, the heat of 4.0 will be emitted in a heater 220.

[0077] the 3rd example of the above — setting — S of drawing 18 — 'amount of heating deltaG of -T' deltaG'=(Tg-Ts') xCp=(70-52.26) x0.24 since it is =4.258kcal/kg — condensator 240 of drawing 15 Q=delta G'xCOP/(COP+1) =4.258x3.0/4.0 =3.194kcal/kg The cooling effect is acquired. The temperature of the processing air after cooling is Tm'-q/Cp=32.29-3.194/0.24=18.98 ** (it is more than evaporating temperature). Therefore, the comprehensive air conditioning effect is set to deltaQ'+q=2.035+3.194=5.229kcal/kg.

[0078] On the other hand, since the drive energy of heat pump is W=delta G'/(COP+1) =4.258 / 4= 1.065kcal/kg, the synthesis COP of this air conditioner is set to COP= (deltaQ'+q) / W= 5.229 / 1.065= 4.910. Usually, since COP of the air conditioner using the steamy compression equation refrigerating cycle for general air-conditioning is about three, according to this example, 39% of energy-saving effect is acquired.

[0079] Next, when the coefficient of performance (COP) in the case of using the zeolite of a well-known example 1 for DESHIKANTO is calculated, since it is delta[from the 1st example] G=4.747 kcal/kg, amount of heating deltaG of S-T of drawing 18 is with the condensator 240 of drawing 15 . Q=delta GxCOP/(COP+1) =4.747x3.0/4.0 = the 3.560kcal [/kg] cooling effect is acquired. Temperature of the processing air after cooling Tm-q/Cp=32.15+0.776-3.560/0.24 = it is 18.09 degrees C (it is more than evaporating temperature). Therefore, the comprehensive air conditioning effect is set to deltaQ+q=2.069-0.186+3.560=5.443kcal/kg.

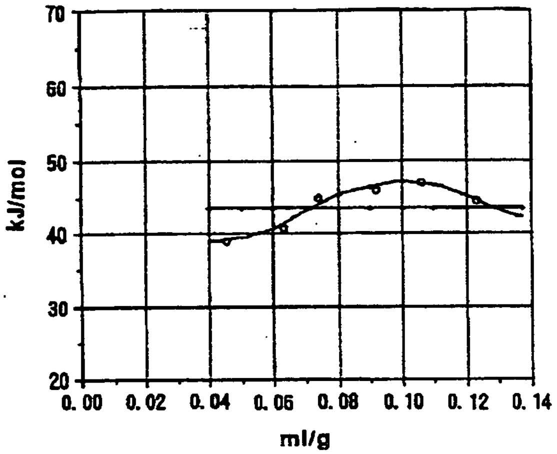
[0080] On the other hand, since the drive energy of heat pump is W=delta G/(COP+1) =4.747 / 4= 1.187kcal/kg, the synthesis COP of this air conditioner is set to COP= (deltaQ'+q) / W= 5.443 / 1.187= 4.586. Therefore, although 35% of energy-saving effect will be acquired to the air conditioner using the steamy compression equation refrigerating cycle for the conventional general air-conditioning in this case, it is lower than the effect of this invention, and, moreover, capacity needs a large thing for heat pump.

[0081]

[Effect of the Invention] As explained above, according to this invention, there is no deliquescence . the maximum of the differential heat of adsorption by 1.1 or less times of the heat of condensation of water And when the adsorption property shown by the adsorption isotherm constitutes an air conditioner using DESHIKANTO which has a suitable isothermal adsorption property for the reproduction temperature which is 65-75 degrees C the amount of heating which the loss of the air conditioning effect and the reproduction of reproduction air resulting from a heat of adsorption take being reduced, and, since the difference which is the amount of water adsorption by the adsorption and desorption of DESHIKANTO uses greatly An air conditioner can be comparatively driven in the heat source of low temperature compared with the former, and it is large, and it is energy saving and the air conditioning effect can offer a compact dehumidification air conditioner.

[Translation done.]

Drawing selection drawing 1 ▼



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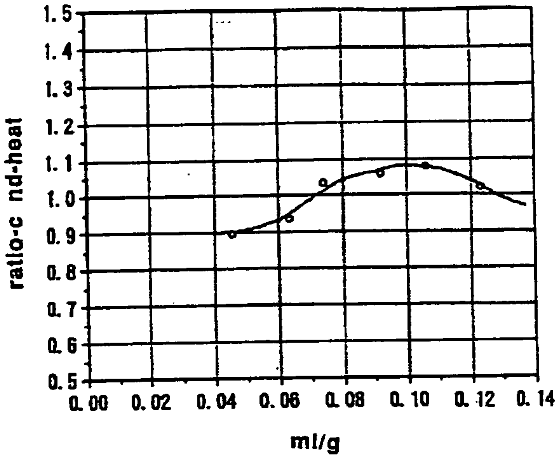
Drawing selection drawing 2



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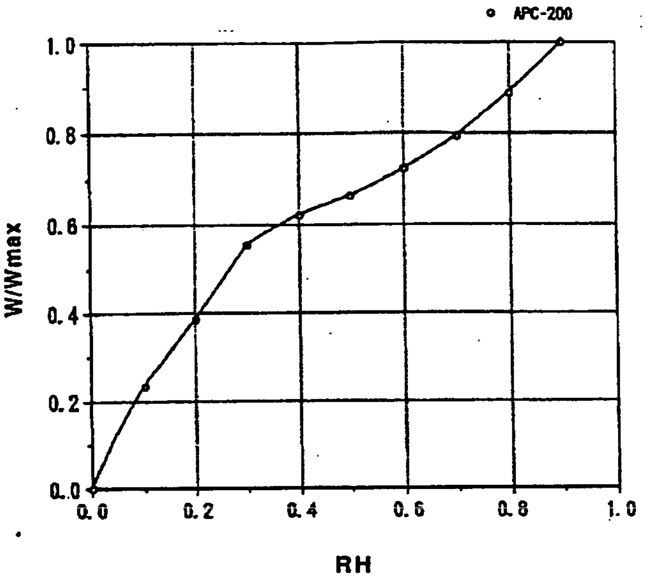
Drawing selection drawing 3 ▼



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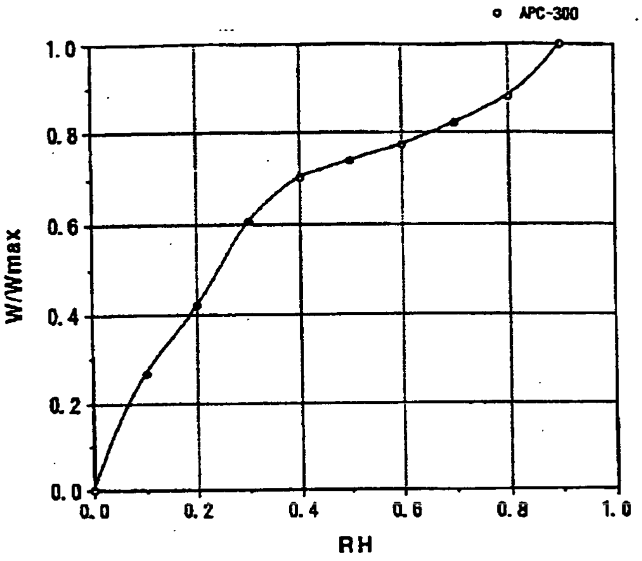
Drawing selection drawing 4 ▼



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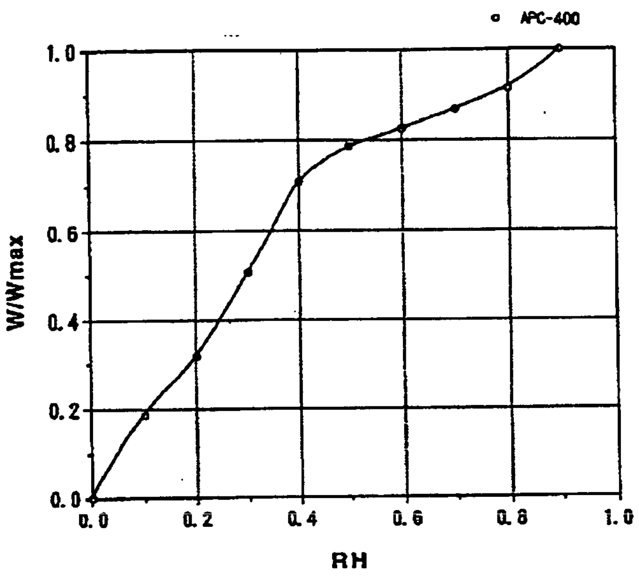
Drawing selection drawing 5 ▼



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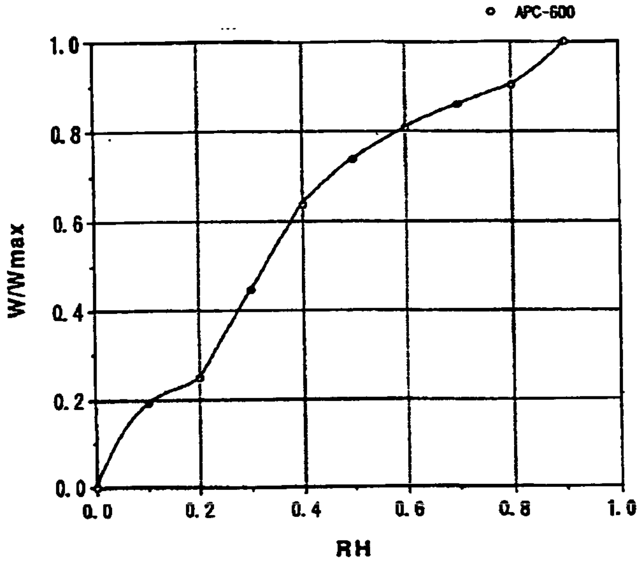
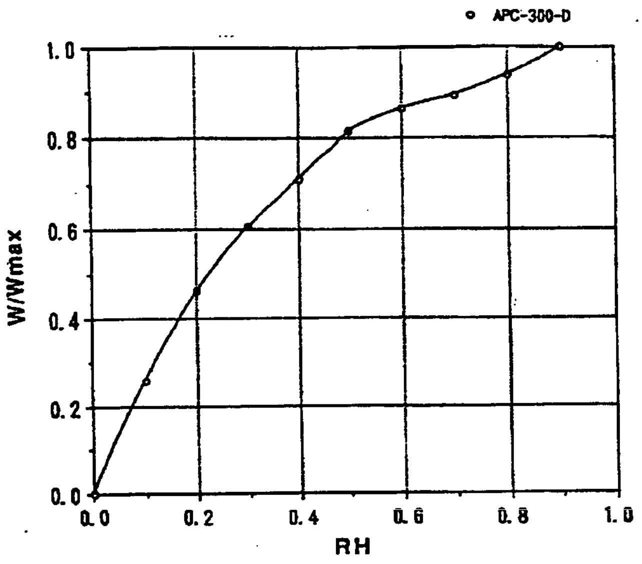
Drawing selection drawing 6 ▼



[Translation done.]

Drawing selection drawing 7 ▼



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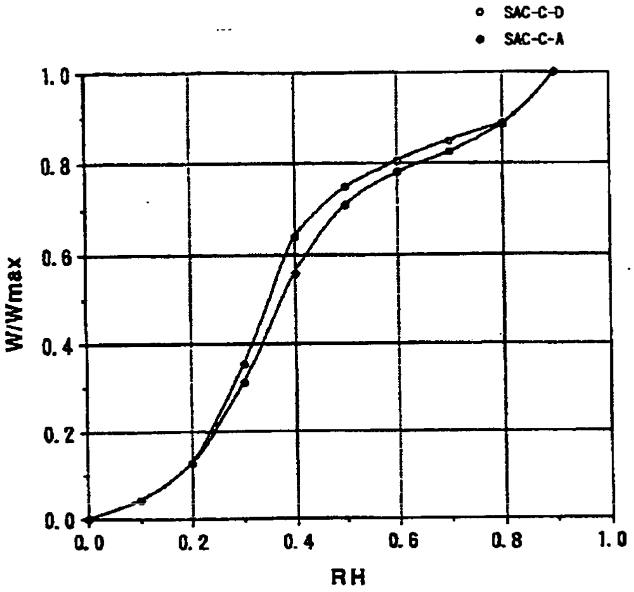
Drawing selection drawing 8 ▼



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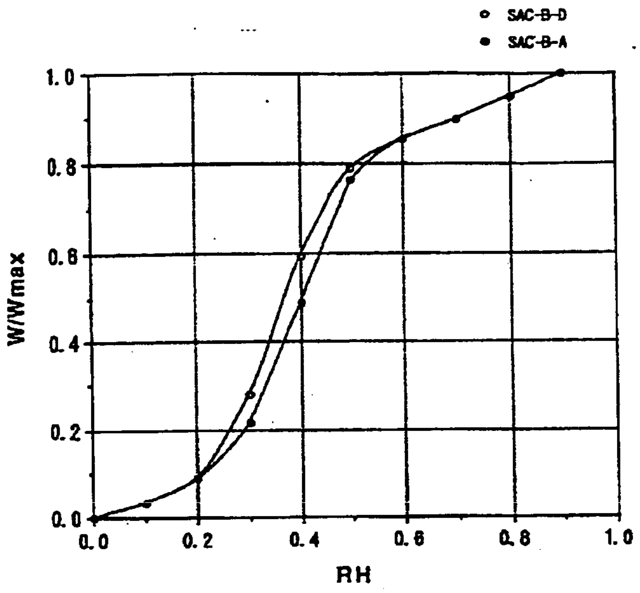
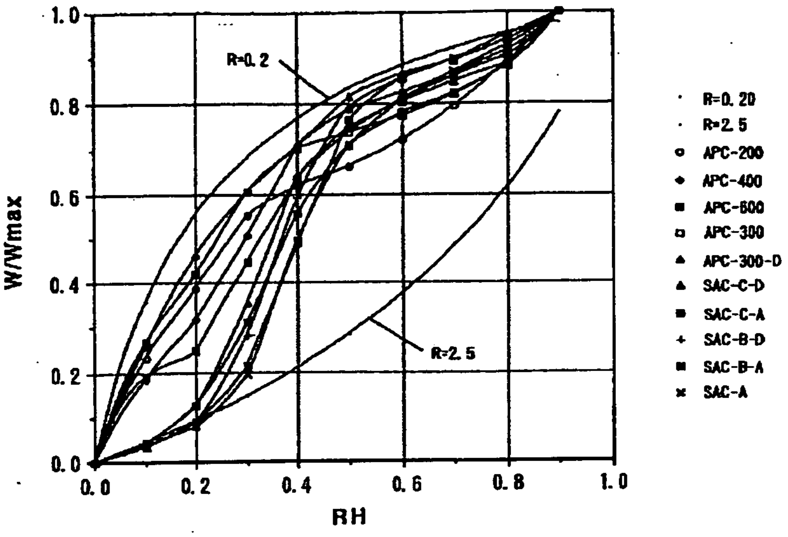
Drawing selection drawing 9 ▼



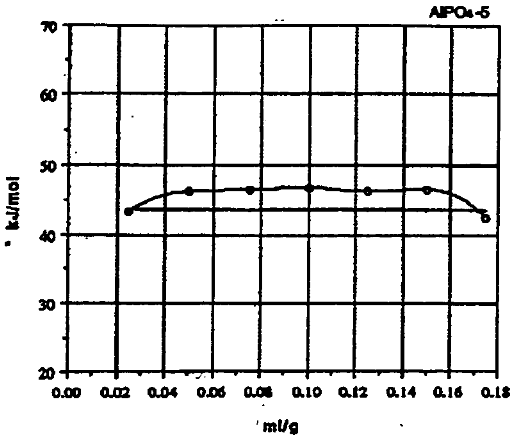
[Translation done.]

Drawing selection drawing 11 ▼



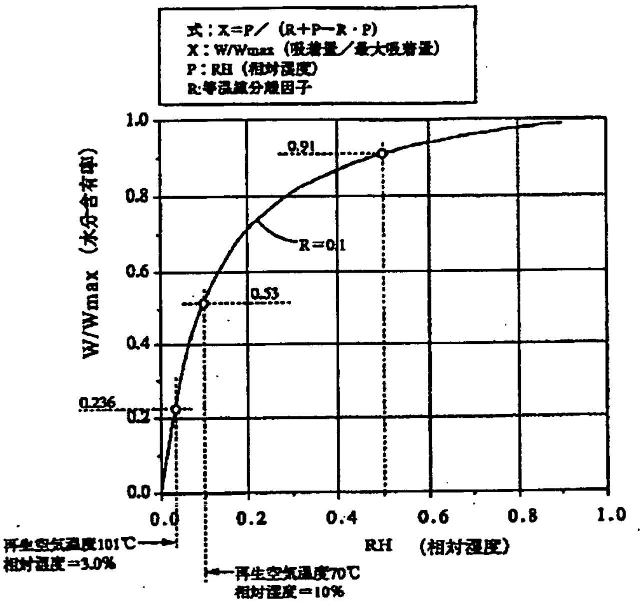
[Translation done.]

Drawing sel ction drawing 12 ▼



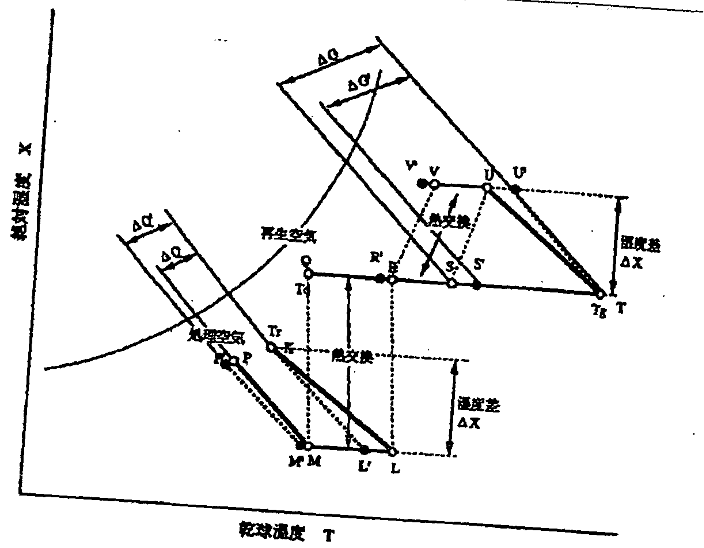
[Translation done.]

Drawing selection drawing 17 ▼



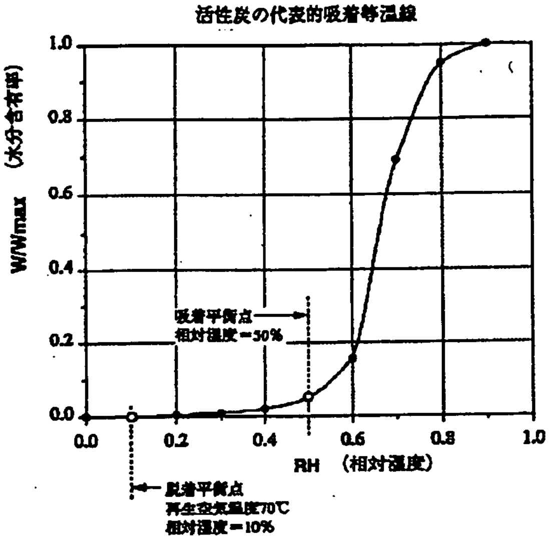
[Translation done.]

Drawing selection : drawing 18 ▼


ΔQ
ΔQ'
ΔQ'
ΔQ
V'
V
U
U'
再生空気
熱交換
湿度差
ΔX
Q
Tc
R'
R
S
S'
Tg
T
Tr
K
処理空気
P'
P
熱交換
湿度差
ΔX
M'
M
L'
L
絶対湿度 X
乾球温度 T

[Translation done.]

Drawing selection drawing 19 ▼



[Translation done.]